

Clinical Outcome of Minimally Invasive Tubular Retractor Assisted Microscopic Discectomy in Far Lateral Lumbar Disc Herniation

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Objective: The purpose of this study is to analyze the clinical outcomes of the minimally invasive approach for the surgical treatment of far lateral lumbar disc herniation.

Methods: Between January 2007 and May 2009, 19 patients who underwent minimally invasive, tubular retractor-assisted microscopic discectomy were retrospectively reviewed. The patients included 11 men and eight women with a mean age of 58 years. The mean symptom duration before surgery was 6.5 months, and the mean follow up time was 20.5 months. Clinical outcomes were assessed according to neurologic status, bleeding volume, surgical time, length of hospital stay, visual analogue scale (VAS) and the modified MacNab's criteria.

Results: The most frequent lesion was at the L4-L5 level (53%), and the mean bleeding volume was 59.3 ml. The mean surgical time and length of hospital stay were 91.1 minutes and 6.4 days, respectively. The mean VAS for radicular pain was improved from 8.37 ± 1.11 before surgery to 1.37 ± 1.33 ($p < 0.05$) at discharge and 0.68 ± 0.89 one year after surgery. The mean VAS for back pain was decreased from 4.63 ± 0.99 before surgery to 2.00 ± 1.23 ($p < 0.05$) at discharge and 0.42 ± 0.61 one year after surgery. The success rates were 100% according to the modified MacNab's criteria, and there were no postoperative complications or recurrences.

Conclusions: The minimally invasive, tubular retractor-assisted microscopic discectomy method is a safe and effective procedure and may be an alternative for treating far lateral lumbar disc herniations.

Key Words: Percutaneous discectomy • Minimally invasive surgical procedures • Far lateral disc herniation

INTRODUCTION

Far lateral lumbar disc herniations compress the exiting nerve root at the same level, outside or lateral to the neuroforamen and comprise between 1-12% of lumbar disc herniations^{1,9,19,27}. This term, 'far lateral' has been known as extraforaminal, extreme lateral and extracanalicular^{12,21,24}. The 'far lateral' area is anatomically defined as the area lateral to the superior and inferior pedicles, with the disc situated anteriorly. And this area is a space lateral to the vertebral body and leading edge of the superior articular facet, with the facet joint dorsally⁷.

Several surgical approaches have been described to reach these lesions. Conventional approaches including midline app-

roach, paramedian approach and combined approach are more complex due to postoperative instability, paraspinal muscle trauma and most spine surgeons are unfamiliar with it. However, tubular retractor assisted microscopic discectomy is minimally invasive approach which offers several advantages.

The present study was performed to analyze clinical outcome of minimally invasive approach in the surgical treatment of far lateral lumbar disc herniation.

MATERIALS AND METHODS

1. Patient Population

A total of 19 far lateral lumbar disc herniation patients who underwent minimally invasive, tubular retractor assisted microscopic discectomy from January 2007 to May 2009 were retrospectively reviewed. The present study included the patients who underwent the surgical procedure due to a single level and side far lateral lumbar disc herniation after 6 weeks of conservative treatment. Patients were excluded if they had

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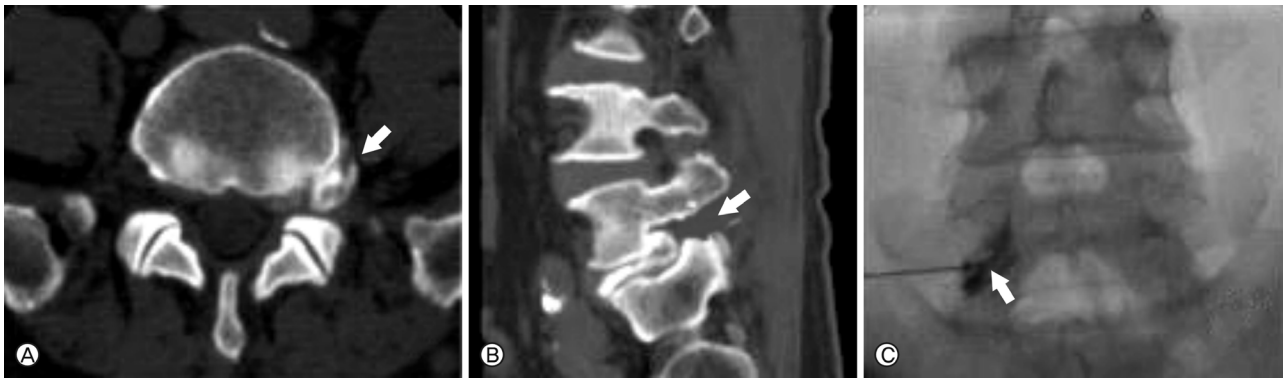


Fig. 1. Left L5-S1 far lateral lumbar disc herniation was shown in axial image (A) and sagittal image (B) on computed tomographic discography. Left L5 Selective nerve root block image (C).

been coexisting spinal stenosis or previous lumbar surgery history. All the patients were evaluated by lumbar computed tomographic (CT) discography, lumbar magnetic resonance image (MRI) and selective nerve root block (SNRB) for diagnosis (Fig. 1). There were 11 men and 8 women and the mean age was 58 years (ranged from 30 to 74 years). The mean symptom duration before surgery was 6.5 months and the mean follow up time was 20.47 months (ranged from 12 to 38 months). The preoperative and postoperative evaluation consisted of neurologic examination, bleeding volume, surgical time, length of hospital stay, pain scale using the visual analogue scale (VAS) and long term outcome using the modified MacNab's criteria. Radicular and low back pain scored using the VAS before surgery, at discharge, and at 1 year after the surgery. The successful outcomes were defined as excellent or good on the modified MacNab's criteria. Data were collected by medical records. Statistical analysis using a two paired t-test was performed with SPSS software for Windows (version 12.0.1; SPSS Inc.). The results were considered statistically significant at a p-value of less than 0.05.

2. Surgical Technique

The minimally invasive, microscopic discectomy used a tubular retractor (METRx system, Medtronic Sofamor Danek, Memphis, TN, U.S.A.). Under general endotracheal anesthesia, the patients were positioned prone on a chest roll. The midline was identified, and a mark was made 1.5 to 2 cm lateral to it, ipsilateral side of the far lateral lumbar disc herniation (Fig. 2). The appropriate level was identified using a spinal needle under the C arm fluoroscope. A 2 to 2.5 cm incision was made and a K-wire was inserted through the incision, directed toward the junction of the transverse process and pars interarticularis of the superior vertebra. The



Fig. 2. The skin incision mark is made 1.5 to 2 cm lateral to midline, ipsilateral side of the lesion.

cannulated dilator was then placed over the K-wire. And then finally, the remaining dilators were placed, and a tubular retractor was held in place (Fig 3). Under microscopic visualization, the transverse process-pars junction was exposed by residual muscle tissue removal. Resection of a small portion of the inferomedial transverse process and the most lateral aspect of the pars was performed using a 3 mm drill and Kerrison punch. At L5-S1 lesion, to avoid sacral ala and iliac crest, the tube retractor positioned more medially than usual and the lateral aspect of the facet joint is drilled and removed. If needed, the superior aspect of the sacral ala is drilled to secure walking space. There by, the lateral aspect of the neural foramen can be opened. And then, the root was exposed with identification of sequestered disc fragments (Fig. 4). Finally, the herniated disc material was removed by pituitary forceps. The surgeon confirmed the root decompression.

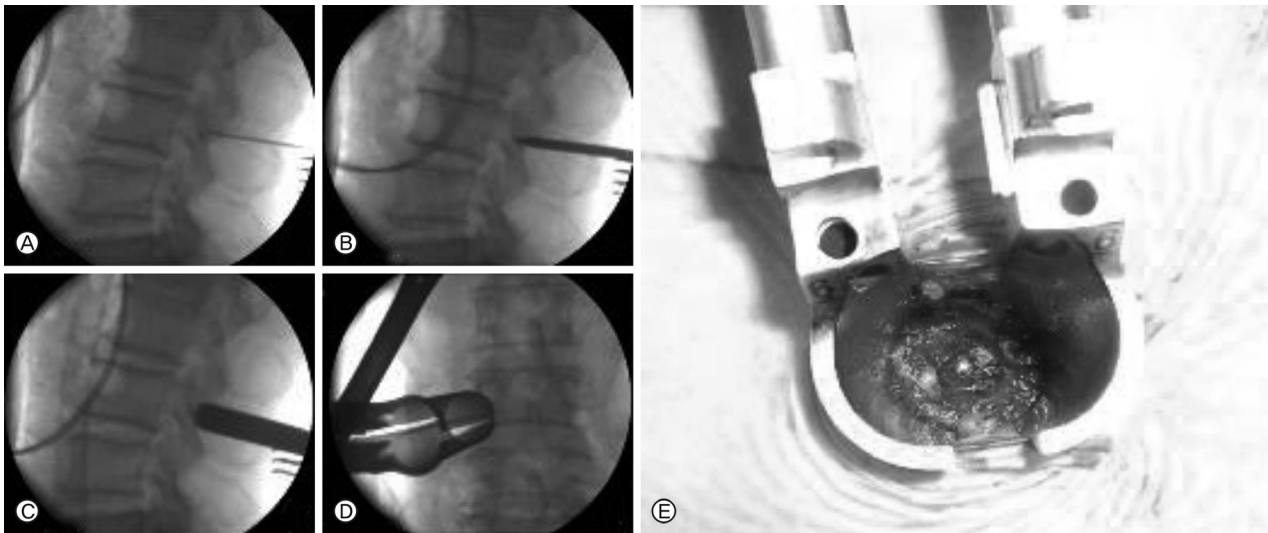


Fig. 3. The K-wire is inserted to the junction of the transverse process and pars interarticularis (A). The initial dilator is placed over the K-wire (B). The remaining cannulated dilator is placed (C). The tubular retractor is placed the junction of the transverse process and pars interarticularis (D). The tubular retractor is placed by an articulated arm on the lesion (E).

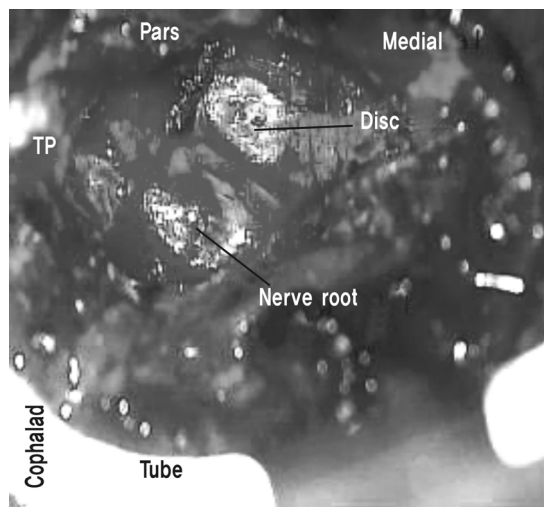


Fig. 4. Intra-operative view of the surgical field. The nerve root and disc are exposed (TP: Transverse process).

RESULTS

The characteristics and clinical parameters of the patients are presented in Table 1. The frequency of affected lesion was highest at L4-L5 level (53%). In the neurologic examination, a positive straight leg raising (SLR) test was present in 10 patients (53%), including all 5 patients with a lesion at L5-S1 level. The positive femoral stretch test (FST) was found in 10 patients (53%), and the most of whom had a lesion at L3-L4 and L4-L5 level (Table 2). The mean surgical time was 91.1

minutes (ranged from 70 to 120 minutes). The mean bleeding volume was 59.3 ml with 6.4 days of the mean length of hospital stay (ranged from 5 to 7 days).

The mean VAS for radicular pain was improved from 8.37 ± 1.11 before surgery to 1.37 ± 1.33 ($p < 0.05$) at discharge and 0.68 ± 0.89 at 1 year after surgery. The mean VAS for back pain was decreased from 4.63 ± 0.99 before surgery to 2.00 ± 1.23 ($p < 0.05$) at discharge and 0.42 ± 0.61 at 1 year after surgery.

At post operative 1 year, the result was excellent for 12 patients (63%) and good for 7 patients (37%). There was no fair or poor outcome. So, the total success rates were 100%. Each surgical outcome is shown in Table 3.

There were no postoperative complications and recurrences.

DISCUSSION

Far lateral lumbar disc herniations and the associated symptoms due to compression of the exiting nerve root were firstly described by Macnab in 1971¹⁵. Far lateral lumbar disc herniations represent 1-12% of all lumbar disc herniations and usually occur in patient who are older than those with typical posterolateral lumbar disc herniations^{1,4,6,8,13,16}. The most frequent lesion is encountered at L4-L5 level (30-60% of cases) followed by L3-L4 and L5-S1 levels^{1,4,5,6}. In our study, L4-L5 level was the most frequent level (53%).

The characteristic feature is that in a far lateral disc compress the nerve root which exits at the same level, whereas in posterolateral disc compresses the nerve root leaving at

Table 1. Patients' characteristics and clinical parameters

No	Age (year)	Sex	Duration of Symptom (mon th)	Pre-op. neurologic state	Affected lesion	Bleeding Volume (ml)	Surgical time (minute)	Length of hospital stay (day)	Follow up period (mon th)
1	55	F	3	sensory deficits	L5/S1, Lt	66	90	7	38
2	72	M	12	pain only	L3/4, Rt.	53	110	7	36
3	65	M	6	sensory deficits	L5/S1, Lt	75	100	7	19
4	51	F	5	pain only	L4/5, Rt.	50	80	6	31
5	30	M	7	altered reflexes	L5/S1, Rt.	80	70	6	25
6	74	F	7	motor deficits	L4/5, Lt.	66	120	6	13
7	54	F	3	pain only	L5/S1, Lt.	55	80	5	24
8	50	M	1	sensory deficits	L3/4, Lt.	40	90	7	12
9	45	F	12	pain only	L4/5, Lt.	70	90	5	15
10	59	M	6	sensory deficits	L5/S1, Lt.	75	100	7	16
11	69	F	12	pain only	L4/5, Lt.	65	120	6	18
12	60	M	10	motor deficits	L4/5, Lt.	80	100	6	13
13	52	M	3	pain only	L4/5, Rt.	71	70	7	28
14	68	M	4	altered reflexes	L3/4, Rt.	33	80	7	15
15	45	M	3	sensory deficits	L4/5, Lt.	40	80	5	18
16	70	F	11	pain only	L4/5, Lt.	58	90	6	22
17	71	M	5	sensory deficits	L3/4, Rt.	42	100	7	14
18	49	M	6	pain only	L4/5 Lt.	47	70	7	12
19	70	F	7	pain only	L4/5, Lt.	60	90	7	20

Table 2. Nerve tension sign on neurologic examination

Level	Number (%)	SLR	FST	SLR + FST
L3/4	4 (21%)	1	3	0
L4/5	10 (53%)	3	6	1
L5/S1	5 (26%)	5	0	0
Total	19	9	9	1

SLR: Positive straight leg raising test

FST: Positive femoral stretch test

Table 3. Long-term outcome after operation (Modified Mac-Nab's criteria)

	No. of patients
Excellent	12 (63%)
Good	7 (37%)
Fair	0 (0%)
Poor	0 (0%)
Success (excellent+good)	19 (100%)

the level below^{7,18)}. The neurologic examination for far lateral lumbar disc herniation involving above the L4-L5 levels may present a positive FST. In the present study, all positive FST were present in L3-L4 and L4-L5 level. Since the L5 nerve root is compressed by L5-S1 level far lateral lumbar disc herniation, there is a high frequency of the SLR limitation. In our study, all patients with a lesion at L5-S1 level have the SLR limitation, too.

The lumbar CT scan and MRI aid in the diagnosis of far lateral lumbar disc herniations⁷⁾. And CT discography and SNRB are good diagnostic tools on far lateral lumbar disc herniation. CT discography demonstrated a far lateral lesion by revealing extravasations of dye far laterally. And SNRB can be present correlation of far lateral lesion with symptom

and prediction of postoperative symptom relief. 0.5 to 0.7 cc of 2% lidocaine and normal saline (1:1 mix) was usually injected to lesion. And then, symptom improvement maintained about 4 to 12 hours. Anatomical diagnosis was confirmed by CT discography and clinical diagnosis by SNRB.

Various surgical approaches have been utilized for treatment of far lateral lumbar disc herniations. Midline approaches are familiar to most spinal surgeons. However, extensive bone resection to provide excellent exposure may lead to postoperative back pain and spinal instability^{5,9,10)}. Wiltse et al. originally described the paramedian approach to far lateral lumbar disc herniations^{28,29)}. This approach requires splitting of muscles with less bone resection and offers a more direct access to the neural foramen. However, paramedian approach

provides deep and disorienting trajectory to the lesion, as well as not familiar with anatomy to many spinal surgeons^{9,11,16,18}. At L5-S1 level, this approach is hindered by the sacral ala and iliac crest¹⁹. The combined approach is working both medial and lateral to the neural foramen^{5,6,10}. Although this approach provides good exposure and less extensive bone resection, it requires longer skin incision and extensive stripping and lateral retraction of the paraspinal muscles, which may lead to postoperative paraspinal muscle pain and dysfunction^{23,26}. The percutaneous endoscopic techniques are minimal invasive method that has been developed recently. Many good surgical results in the literature have been reported, however, it requires highly experienced endoscopic skills. Moreover, calcified disc material, facet hypertrophy, short pedicle, severe foraminal stenosis, and L5-S1 lesion (high lying iliac crest) is limitation of this approach^{2,14}.

Foley and Smith firstly introduced the microendoscopic discectomy with METRx system for lumbar disc herniation in 1997⁸. They described that this technique is a less invasive and more effective technique for treatment lumbar spinal disorder⁹. This system allows the application of endoscopic techniques to conventional surgery. The advantages of microendoscopic discectomy include smaller incision, lesser postoperative pain, early ambulation, short hospital stay, shorter time to return to work and lesser cost of treatment^{3,17,20,22,25}. This technique has been adapted to treatment of far lateral lumbar disc herniations. The tubular retractor assisted microendoscopic discectomy for the surgical treatment of far lateral lumbar disc herniations was initially reported by Foley et al. in 1999⁹.

The minimally invasive, tubular retractor assisted microscopic discectomy is a similar procedure to microendoscopic discectomy. The endoscope was replaced by the surgical microscope. The goal of minimally invasive approach is to reduce postoperative pain and recovery time while maintaining proper visualization. This approach has all advantages of microendoscopic discectomy including a shortened operative time and with less muscle destruction, preservation of the facet joint and preservation of surrounding soft tissues. In addition, this system enables direct surgical images to be viewed and has the advantage of both hands free and therefore two separate instruments can be used simultaneously under the surgical microscope. It is more familiar to most spine surgeons. This minimally invasive approach also has some disadvantages. The procedure is technically challenging and more difficult with severe obesity. Direct repair of dural tears is not possible. And complex pathologies including severe spinal or foraminal stenosis were needed conventional open approach than minimally invasive approach. In addition, L5-S1 level far lateral lumbar disc herniation is more challenging due to

the narrow operative window, which is limited by sacral ala and iliac crest. In 5 cases of L5-S1 lesion that had been experienced in this study, we positioned the tube retractor more medially than usual and drilled the lateral aspect of the facet joint to avoid sacral ala and iliac crest.

In the present study, the mean bleeding volume was 59.3 ml. And 2 cm surgical skin incision at L3-L4 and L4-L5 level and 2.5 cm incision at L5-S1 level were made. There were lower volume and shorter size than conventional open surgery^{18,28}. The mean surgical time was 91.1 minutes, which is shorter than the mean surgical time (110 minutes) with paramedian muscle splitting approach in previous literature¹¹. It means that the tubular retractor assisted microscopic discectomy is minimal invasive surgery for treating far lateral lumbar disc herniations.

The mean VAS for radicular pain was improved from 8.37 ± 1.11 before surgery to 1.37 ± 1.33 at discharge and 0.68 ± 0.89 at 1 year after surgery was observed. The mean VAS score for back pain was decreased from 4.63 ± 0.99 before surgery to 2.00 ± 1.23 at discharge and 0.42 ± 0.61 at 1 year after surgery. All patients had improved both radicular and back pain and there were statistically significant difference ($p < 0.05$). However, this study was not compared with a control group and performed analysis of muscle injury. In the future, the study should be compared with a control group and analyzed preoperative and postoperative muscle enzyme to confirm and minimally invasive procedure.

The success rates were 100% using the modified MacNab's criteria. This surgical outcome is similar to the success rates (68-100%) reported in the other studies^{1,4,5,6,16,18}. The reported complications in patient undergoing tubular retractor assisted microendoscopic discectomy include wound infections (0-0.8%), discitis (0-0.8%), dural tears (2.3-7.1%) and recurrent disc prolapse (2.6-2.9%)^{3,20,22}. In this study, complications were not experienced. It means that the minimally invasive, tubular retractor assisted microscopic discectomy is a safe procedure for treating far lateral lumbar disc herniations. However, this outcomes are limited due to small number of patients and shorter follow up period. So, In the future, the study should be collected larger cases and longer term data and analyzed outcomes by further clinical parameters including analgesic using time and changes of disc height in radiologic study.

CONCLUSION

The minimally invasive, tubular retractor assisted microscopic discectomy has advantages including minimal surgical trauma and preservation of spinal stability. This technique is

recommendable due to similar success rate, safety and early recovery. Moreover it may be an alternative for treating far lateral lumbar disc herniations.

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